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NAVAL UNDERWATER SYSTEMS CENTER
NEWPORT R I

NORLANT 72 PHASE 2 OPERATION PLAN. (U)
JUN 72

GDS NUSC-TD-4369

ABSTRACT

This document describes the scientific aspects of the signal and noise directionality, ambient noise, bottom characteristics, and oceanographic experiments that comprise Phase 2 of NORLANT 72. Experiment descriptions, data processing and reporting plans, levels of effort, and principal personnel are delineated for the studies to be conducted July-August 1972 in the Labrador Basin.

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LIST OF ABBREVIATIONS

AXBT	Aircraft expendable bathythermograph
CDA	Cross-dipole array
CFAV	Canadian Forces Auxiliary Vessel
COMEX	Commencement of exercise/event
CONGRATS	Continuous-gradient ray-tracing system
CTD/SV	Conductivity-temperature-depth/sound-velocity (probe)
CW	Continuous wave
DREA	Defense Research Establishment Atlantic (Canadian)
FINEX	End of exercise/event
FNMC	Fleet Numerical Weather Central
GMT	Greenwich mean time
IOMEDEX	Ionian Mediterranean Exercise
LDGO	Lamont-Doherty Geophysical Observatory
LRAPP	Long-Range Acoustic Propagation Project
MABS	Moored acoustic buoy system
NAVOCEANO	Navy Oceanographic Office
NFEC	Naval Facilities Engineering Command
NRL	Naval Research Laboratory
NUSC	Naval Underwater Systems Center
NUSC/NL	New London Laboratory, Naval Underwater Systems Center
ONR	Office of Naval Research
PDR	Precision depth recorder
RF	Radio frequency
R/V	Research vessel
S/N	Signal-to-noise ratio
SOA	Speed of advance
SSOB	Senior scientist on board

LIST OF ABBREVIATIONS (Cont'd)

STD	Salinity, temperature, depth (profile)
SUS	Signal, underwater sound
SVP	Sound-velocity profile
TABS	Telemetering acoustic buoy system
USB	Upper sideband
USNS	U.S. Naval Ship
USOP	Undersea Surveillance Oceanographic Project
VLA	Vertical line array
VLAM	Vertical-line-array measuring (system)
XBT	Expendable bathythermograph
Z	Time zone Z (Greenwich mean time)

NORLANT 72 PHASE 2 SCIENTIFIC PLAN

I. GENERAL

(U) This scientific plan includes a description of each experiment to be conducted during Phase 2 of NORLANT 72 and a data processing and reporting plan. In addition, levels of effort and the principal investigators for each experiment are identified. With the exception of signal and noise directionality measurements, the experiments are being conducted from USNS SANDS by the Naval Underwater Systems Center (NUSC), with the bottom acoustic characteristics experiment being a joint effort with the Lamont-Doherty Geophysical Observatory. The signal and noise directionality measurements will be obtained by the Naval Air Development Center (NADC) using the vertical line array measuring (VLAM) system deployed from R/V PIERCE. The parts of the noise versus depth measurements using NADC AUTOBUOYS deployed from R/V LANGEVIN II, bottom loss measurements using SONOBUOYS and aircraft-dropped charges, and shipping surveillance with NADC aircraft are also included under the directionality measurements because they are part of a totally integrated experiment that supports such measurements.

II. SCIENTIFIC ORGANIZATION

(U) The organization for the Phase 2 scientific plan is as follows:

a. Commands

Office of Naval Research Code 102-OS — Program Sponsor for NUSC

Manager, ASW Systems Projects ASW-21 — Program Sponsor for NUSC

Naval Facilities Engineering Command FPO-1 — Environmental Modeling

b. Scientific Staff

R. Martin, NUSC Chief Scientist

K. W. Lackie, USOP — Operations, Logistics, and Oceanographic Data Coordinator

J. Syck, NUSC — Assistant Oceanographic Data Coordinator

c. Senior Scientists On Board

R. Martin, NUSC	SANDS, 29 July - 8 August
S. Santaniello, NUSC	SANDS, 9 - 20 August
P. Van Schuyler, NADC	R/V PIERCE, 29 July - 10 August
L. Allen, NADC	R/V LANGEVIN, 29 July - 10 August
F. Doerstling	EC 121 A/C, 29 July - 12 August

III. EVENT 1 — DEEP OCEAN AMBIENT NOISE MEASUREMENTS

OBJECTIVE

(C) The objective of this event is to statistically describe the ambient noise level characteristics of the Labrador Basin for parameter ranges pertinent to fixed, mobile, and deployable surveillance systems, in the frequency interval 10 to 2500 Hz and depth interval 100 to 12,000 ft, as a function of geographic location. Hourly 30-sec samples taken over a period of 30 days on the five MABS hydrophones, spaced at depths ranging from 250 to 2000 ft, will provide data for determining mean levels, variances, correlations with environmental factors, and the geographic dependence of ambient noise. The supporting environmental data will be obtained principally from PIERCE, LANGEVIN, and SANDS. Analysis bands will be 1/3-octave. Supplemental data will be obtained by NRL during the first deployment period. In addition, SONOBUOYS (at depths of 100 and 300 ft) and NUSC's AUTOBUOY (at depths of 2,000 to 12,000 ft) will be deployed in the vicinity of MABS and at other geographic positions to obtain broader geographic coverage.

OVERVIEW

(C) MABS will have been deployed for a seven-day period and retrieved at site M-1 during the Phase 1 measurement period. It will be refurbished and redeployed at site M-2 to sample noise for a 30-day period. NUSC's AUTOBUOY will be deployed in the vicinity of MABS to obtain concurrent data at deeper depths than obtainable by MABS. During the NUSC AUTOBUOY event, SONOBUOYS will sample continuously at 100- and 300-ft depths. In addition, NADC AUTOBUOYS and SONOBUOYS will be deployed in the vicinity of VLAM during this event.

MAJOR EQUIPMENT AND FACILITIES

(C) The major facilities are as follows.

- SANDS (deploy MABS, AUTOBUOY, and SONOBUOYS)
- MABS (five hydrophones, 250 to 2000 ft, simultaneously sampled)
- AUTOBUOY (ambient noise at five depths, 2,000 to 12,000 ft, serially sampled)
- SONOBUOYS (ambient noise at 300 and 100 ft, concurrently)

DESCRIPTION OF EXPERIMENT

(C) MABS will be deployed at site M-2 with hydrophones at depths of 250, 450, 1000, 1500, and 2000 ft. MABS will be programmed to sample hydrophone outputs for 30 sec each every hour for 30 days, at which time the data tape will be full. Data will be recorded on tape in the frequency band 10 to 2500 Hz. During this 30-day period, SANDS or PIERCE will be in the general vicinity of MABS and will maintain a log of environmental conditions in the area. After MABS is in place, the NUSC AUTOBUOY will be deployed by SANDS to sample data at depths of 12,000, 9,500, 5,600, 4,000, and 2,000 ft. A 20-min sample will be collected at each depth in the frequency band 8 to 2500 Hz. After AUTOBUOY is deployed, SANDS will open range 2 nmi, deploy two SSQ-57A SONOBUOYS set for depths of 100 and 300 ft, open range an additional 3 nmi, and go to quiet ship conditions to record the telemetered data from the SONOBUOYS.

DATA PROCESSING PLAN

(C) The data from MABS will be processed in 1/3-octave bands from 3.15 to 2500 Hz, using a tape speed-up ratio of 8 to 1 to enhance the low-frequency signal-to-noise ratio (S/N). MABS data will be grouped according to wind speed and hydrophone depth and will be presented as averaged spectral plots. There will be one plot for each wind speed group and hydrophone. AUTOBUOY and SONOBUOY data will be processed in the same manner to obtain an averaged spectral plot for each hydrophone depth. One 15-min average will be obtained for each AUTOBUOY depth, and contiguous 15-min averages will be obtained for the SONOBUOY data.

(U) MABS data will be further analyzed for

- Zero-delay correlation of wind speed and 1/3-octave time series.
- Mean and standard deviation versus frequency for each wind speed group and hydrophone depth.
- Autocorrelation of the ambient noise 1/3-octave time series.

DATA REPORTING PLAN

(U) The data reporting plan includes

- A preliminary report showing ambient noise level versus depth measurements and spectral plots of grouped data, by 1 November 1972.
- A final report, with complete analysis, showing wind speed effects and fluctuation data, by 1 February 1973.

LEVEL OF EFFORT

(U) The level of effort requirement is

- 1/3-octave processing of MABS, AUTOBUOY, and SONOBUOY data . . . . . 1 man-month
- Data formatting and editing . . . . . 1 man-month
- Preliminary data analysis and reporting . . . . . 1 man-month
- Final data analysis and reporting . . . . . 3 man-months

PRINCIPAL INVESTIGATOR

(U) The principal investigators for this event are R. Martin and A. Perrone, NUSC.

IV. EVENT 2 — SIGNAL AND NOISE DIRECTIONALITY MEASUREMENTS

OBJECTIVES

(C) The objectives of this event are

a. Measure vertical directionality of the signal plus noise and noise fields in deep water to provide data with which to determine the need for vertical directivity in fixed and deployable surveillance system array design. Signal frequencies of 77, 85, 96, 128, 346, and 384 Hz will be used, and data will be processed by NADC through the 360-ft, 26-element VLAM array.

b. Measure omnidirectional noise (10 to 2500 Hz) and signal level at each of nine depths, using the NADC AUTOBUOYS in the vicinity of VLAM.

c. Obtain supporting shipping distribution data (signatures, density) in the vicinity of VLAM, using aircraft and deployed SONOBUOYS.

OVERVIEW

(U) NADC has developed the VLAM system to measure the vertical directionality of ambient noise and signals. To support these measurements, NADC has contracted for two supply boats, PIERCE and LANGEVIN. PIERCE will be used to deploy and tend VLAM, and LANGEVIN to deploy two NADC AUTOBUOYS (for supporting measurements) and two signal sources. In addition, an NADC aircraft will be used to provide shipping surveillance and to obtain SONOBUOY ambient noise measurements and response to bottom-reflected signals. All these facilities will be used in one coordinated experiment that will last eight days and is designed to meet the stated objectives. From this eight-day sequence, a total of 10 hours of VLAM data will be selected for processing. VLAM will be deployed "upstream" of the selected site so that it will drift over the site during the eight-day period.

(C) NADC had previously planned to work in the vicinity of Iceland in August 1972 (sponsored by ASW-21) and has offered to coordinate these plans with the ONR-sponsored NORLANT 72 experiment in the Labrador Basin. During NORLANT 72, SANDS and the HX 231F acoustic source will participate in the NADC experiment, with SANDS taking station at ranges of 200 and 300 nmi from VLAM.

MAJOR EQUIPMENT AND FACILITIES

(C) The major facilities are as follows:

- PIERCE (VLAM support boat and acoustic sources)
- LANGEVIN II (NADC AUTOBUOYS and acoustic sources)
- NADC aircraft (shipping surveillance, SONOBUOYS, bottom loss)
- VLAM (360-ft array of 26 hydrophones)
- LANGEVIN sources (77 and 346 Hz at 90 dB// 1 μbar source level)
- PIERCE sources (77 and 384 Hz at 90 dB//1 μbar source level)
- SANDS source (85.47 and 128.205 Hz at 90 dB//1 μbar source level)
- NADC AUTOBUOYS (two units sampling noise at a total of nine different depths)
- SONOBUOYS (ambient noise and bottom-loss data collection).

DESCRIPTION OF EXPERIMENT

(C) An eight-day experiment that essentially repeats measurements every two days will begin on 31 July with a nine-depth AUTOBUOY deployment followed by the VLAM deployment and noise directionality measurements. During the AUTOBUOY test interval, two AUTOBUOYS, each programmed for five depth stations, will be deployed simultaneously from LANGEVIN. While the AUTOBUOYS are descending to the first depth station, LANGEVIN and PIERCE will take designated stations 5 to 20 nmi away and lower CW sources set to start pulsing at the programmed start time of AUTOBUOY data taking. Pulsing will continue until completion of the last depth station; sources will then be retrieved and AUTOBUOY recovered. The AUTOBUOY test will take approximately 10 hours. After VLAM is deployed, it will remain in the water, drifting for the eight-day period. VLAM will be turned on for a 27-hour period approximately every 18 hours, and the telemetered data will be recorded on PIERCE. During this measuring period, CW sources will be lowered from PIERCE 5 to 20 nmi from VLAM, and from LANGEVIN 20 to 50 nmi from VLAM. These sources will operate at 100- or 500-ft depths for 45 min in a three-hour period at one range; the ship will then move out in range and repeat the procedure for additional three-hour periods.

(C) Aircraft surveillance and SONOBUOY data acquisition will take place within a 50-nmi radius of VLAM. Aircraft crews will fly 10 hours/day for three days and then rest for two days. Flights will occur on 31 July, 1 - 2 August, and 5 - 7 August. On 10 August, a special flight will be made to obtain the bottom-loss measurements. During each flight, 10 SONOBUOYS and eight AXBT's will be deployed within the surveillance area. The acoustic data will be recorded continuously. The bottom loss measurements will involve dropping 25 SUS Mk 61's to detonate at a depth of 800 ft along four 50-nmi tracks (east, west, north, and south) extending from a SONOBUOY with hydrophone at 300 ft.

DATA PROCESSING PLAN

(C) Individual hydrophone outputs from VLAM will be recorded and computer-processed to form 23 vertical beams steered from +90 to -90°. This beam output data will be processed in 1/2% filter bands at eight selected center frequencies (f_0) including the four projector frequencies. Four noise directionality plots will be generated in 1/2% contiguous bands on each side of each center frequency. These are the noise directionality plots. In addition, plots will be generated using nine different spatial processing techniques (cardioid, dipole, nulls, etc.) for comparison of techniques.

(U) AUTOBUOY data will be processed to obtain S/N versus depth statistics.

(U) Aircraft surveillance will include the quantity, rigging, and signatures of ships nearest to VLAM.

DATA REPORTING PLAN

(U) The data reporting plan includes

- A preliminary report showing signal and noise directionality curves for eight frequencies and AUTOBUOY noise versus depth curves, by 15 November 1972.
- A final report by 3 March 1973.

PRINCIPAL INVESTIGATOR

(U) The principal investigator for this event is E. Garabed, NADC.

V. EVENT 3 — BOTTOM ACOUSTIC CHARACTERISTICS

OBJECTIVES

(C) The objectives of this event are

a. Measure the bottom loss as a function of grazing angle (5 to 90°) and frequency (20 to 1000 Hz).

b. Measure the average sediment layer depth and sound speed, using seismic reflectivity techniques.

OVERVIEW

(C) Phase 2 of the NORLANT 72 experiments will investigate the acoustic and geological characteristics of selected ocean bottom sites in the Labrador Basin. This event is concerned with the objectives, acquisition systems, operations, and processing involved in determining the bottom acoustic characteristics of these sites. Two organizations, NUSC and the Lamont-Doherty Geographical Observatory (LDGO), will jointly participate in the Phase 2 operation. NUSC will be responsible for the first objective, and LDGO will be responsible for the second.

(C) To meet the first objective, NUSC will deploy the TABS and AUTOBUOY from SANDS so that the hydrophones are deep in the water (800, 3000, and 6000 ft); see figure 1. SANDS will also deploy Mk 94 explosives set to detonate at 3000 ft as the ship opens range from the measuring site. This geometry is used to ensure that the bottom-reflected signals received at the hydrophones (over a wide grazing-angle coverage) will not be intermingled with other major water path arrivals.

(C) To meet the second objective, LDGO will deploy from SANDS, a SONOBUOY, AIR GUN, and a small towed receiver array required for the seismic reflectivity data acquisition. The standard seismic reflectivity techniques will be extended by employing a calibrated SONOBUOY (AN/SSQ-57A), which will allow amplitude analysis of bottom-reflected signals.

MAJOR EQUIPMENT

(U) The major equipment includes

- Mk 94 explosives set at 3000 ft. . . . NUSC
- TABS . . . . . NUSC
- AUTOBUOY . . . . . NUSC

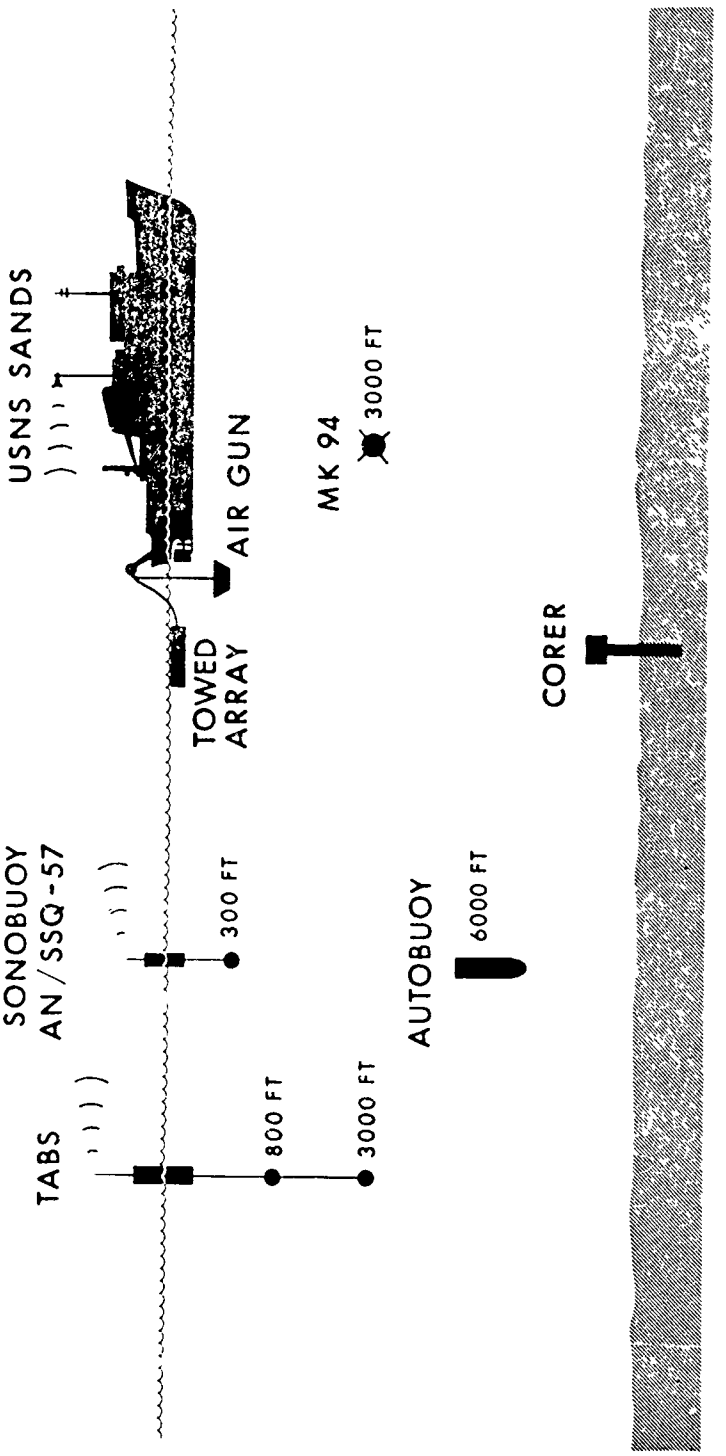

Figure 1. (C) NORLANT 72 Phase 2 Bottom Acoustic Characteristics Acquisition Systems (U)

- Two-hydrophone array (backup) . . . . . NUSC
- Velocimeter . . . . . NUSC
- XBT (with auncher, 4/day = 48) . . . . . NUSC
- Piston corer. . . . . NUSC
- Boomerang corer, 10 . . . . . NUSC
- AN/SSQ-57A SONOBUOY, 8 . . . . . NUSC
- AIR GUN (compressor supplied by NUSC). . LDGO
- Small towed receiving array. . . . . LDGO

DESCRIPTION OF EXPERIMENT

(C) During Phase 2, the bottom acoustic characteristics will be measured at two locations: 15 nmi southeast of site M-1 and 15 nmi east of site M-2. SANDS will deploy acoustic receiving systems at each site and will transit radially four times while activating the AIR GUN or launching Mk 94 explosives. Each radial transit from the measurement site will consist of a two- or three-leg operation (see figure 2). The four radial tracks will extend approximately northeast (three legs), southwest (two legs), northwest (three legs) and southeast (two legs) from the site. Each of the two tracks north of the measurement site will extend a straight-line distance of 30 kyd from the measurement site; each of the two tracks south of the measurement site will extend a straight-line distance of 15 kyd from the measurement site.

(C) At each measurement site (M-1, M-2), SANDS will deploy the following acoustic receiving systems prior to the three-leg transits.

- TABS, with one hydrophone at 800 ft and one at 3000 ft.
- AUTOBUOY, set for 6000-ft and a three-hour start delay.
- SONOBUOYS (AN/SSQ-57A).

For the two-leg transits, only the TABS and the SONOBUOYS will be deployed.

(C) Operations for a three-leg transit will be as follows:

a. Leg 1 — SANDS will deploy an AIR GUN and a small towed array and will transit along a radial track for approximately 15 kyd from the deployment site, firing the AIR GUN at a 10-sec repetition rate. SANDS will record the data received via the TABS and SONOBUOYS. The SOA will be 6 to 7 knots, so that the leg 1 transit will be completed in less than two hours. SANDS will retrieve the AIR GUN and towed array at the end of the leg.

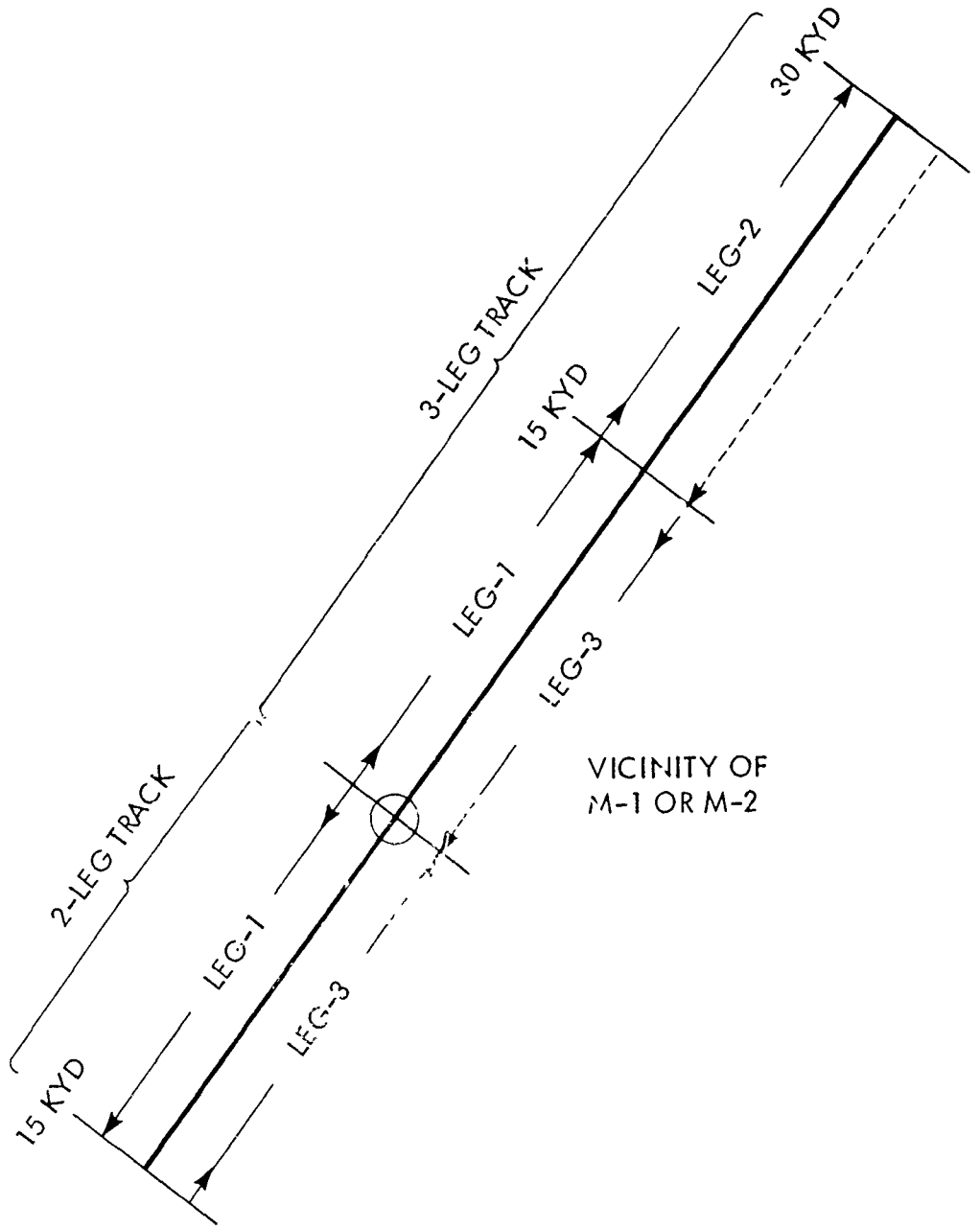

Figure 2. (C) USNS SANDS Track Chart During Bottom Acoustic Measurements (U)

b. Leg 2 — SANDS will commence leg 2 at a distance of 15 kyd from the deployment site and will traverse another 15 kyd along the radial track, launching Mk 94 charges set to detonate at a depth of 3000 ft. AUTOBUOY will be set to commence recording data three hours after deployment, i.e., to commence recording at the beginning of the leg 2 transit so as to be synchronized with the operation. The SOA of SANDS will be 3 knots and the launching rate for the explosives will be one each every 3 min. At the end of leg 2, SANDS will come about and return to the leg 2 commencement range of 15 kyd at an SOA of 8 to 10 knots.

c. Leg 3 — SANDS will commence at a distance of 15 kyd from the deployment site and return along the leg 1 track at an SOA of 3 knots. SANDS will launch the Mk 94 explosives at a rate of one each every 3 min until the ship is 10 kyd from the site. At 10 kyd, the launching rate will be one each every 2 min and will continue until SANDS reaches the original deployment site. During leg 3, SANDS will record the acoustic data received via TABS.

(U) When SANDS returns to the original deployment sites after a three-leg transit, it will retrieve the AUTOBUOY and commence two-leg operations along a radial track 180°T from the three-leg radial track. The two-leg operations will eliminate leg 2 of the three-leg operations.

DATA PROCESSING PLAN

(C) All acoustic data will be recorded in analog form. The analog tapes will be played back at sea to check the quality and quantity of the data. The analog tapes generated by TABS and AUTOBUOY will be digitized at NUSC for processing by NUSC's UNIVAC 1108 digital computer. The analog data will be low-pass filtered to 1200 Hz and will be digitized using a sampling clock signal recorded on a separate channel of the analog data tape. The digitizing rate will be 2000 samples per second, i.e., 5 kHz; thus, the instantaneous signals for all pertinent acoustic arrivals will be digitized for further processing.

(U) To process these data, a "look-up" table using the techniques described in the PARKA IIA bottom loss report* will have to be developed. This will require on-site velocimeter data (used as inputs to the NUSC CONGRATS ray tracing program) to develop the expected (1) time difference between major water path arrivals, (2) the propagation loss along each path, and (3) the grazing angle of the bottom-reflected signal — each as a function of range for a partic-

*S. R. Santaniello and S. R. van der Veen, "PARKA IIA Bottom Loss Measurements" (U), NUSC Technical Memorandum No. 2211-023-70, 29 June 1970 (CONFIDENTIAL)

ular average water depth over the measuring tracks. Thus, as the data is processed, the time differences in arrival of major water path signals are compared with the "look-up" table to estimate the propagation loss, to determine the bottom loss, and to estimate the grazing angle of the measured bottom-reflected signal.

(C) First, the digitized values of the instantaneous signal arrivals will be digitally filtered in the following six 1/3-octave bands:

f_o(Hz)	Bw (Hz)
25	6
50	12
100	23
200	46
400	92
800	184

The digitally filtered values will be subjected to amplitude threshold criteria to isolate each major water path arrival: direct, bottom-reflected, surface-reflected, etc. The energy within each arrival will be determined by squaring and integrating the detected signal arrivals. Since the geometric arrangement during acquisition of the data ensures time separation between major water path arrivals, the energy in the bottom-reflected arrival will be compared with the energy in the direct arrival after an appropriate propagation-loss adjustment for each path. This will result in a determination of the true bottom loss over the operational track.

(C) Bottom-loss data will be obtained over four radial tracks at the two measurement sites. The NUSC AUTOBUOY is to be used only for the northeast and northwest tracks*; therefore, the data acquired over the northeast and southwest tracks will be combined to produce a bottom loss versus grazing angle curve for each of the six frequency bands, and the data acquired over the northwest and southeast tracks will be combined to produce a similar set of curves. Thus, for each site, there will be three sets of bottom loss curves, and each set will consist of curves for the six frequency bands. To develop a smooth

* See the NORLANT 72 Phase 2 Operations Plan, NUSC Technical Document No. 4367 (CONFIDENTIAL).

bottom loss curve as a function of grazing angle, the bottom loss values composing a set of data will be averaged over each 5° angle bin, from 0 to 90°. Approximately 300 bottom loss values will be used to produce the combined bottom loss curves for a site.

DATA REPORTING PLAN

(U) The data reporting plan includes

- A preliminary report containing bottom loss versus grazing angles for the NORLANT .4 measurement site, by 1 November 1972.
- A final report covering acquisition, processing, analysis, and results, by 1 February 1973.

LEVEL OF EFFORT

(U) The level of effort requirement is

- Data processing . . . . . 3 man-months
- Data reporting . . . . . 3 man-months

PRINCIPAL INVESTIGATOR

(U) The principal investigator for this event is S. Santaniello, NUSC.

VI. EVENT 4 — LONG-TERM OCEAN CURRENT, SALINITY, AND DEPTH MEASUREMENTS

OBJECTIVES

(C) The objectives of this event are

a. Obtain long-term, high sample rate measurements of the temperature, salinity, and current velocity fields as a function of time and depth at a selected site in the Labrador Basin.

b. Relate observed variability in the sound speed structure to characteristics of the Labrador oceanographic regime and attempt to predict the magnitude of seasonal acoustic variations.

c. Submit analysis of water current profile for use in (1) interpreting performance of MABS, TABS, AUTOBUOY, and ambient noise buoys (ANB's) and (2) NAVFAC evaluation of suspended array structure design.

BACKGROUND

(U) During the 1972 exercise, sound transmission measurements will define the acoustic medium at several sites in the Labrador Sea. In this area, water of Arctic origin meets the North Atlantic water mass, forming a complex oceanographic region influenced by perturbations of the Gulf Stream-North Atlantic current system. Only by accurately resolving the broad time-space spectrum of expected inhomogeneities can oceanographic structures responsible for acoustic variability be isolated. Once these relationships are understood, results of the localized experiment can be extrapolated.

(U) The IOMED exercise of July 1971 employed three environmental sensors in the MABS acoustic array. Each sensor provided an internally recorded time series of nine oceanographic and engineering parameters sampled at 5-min intervals. These units were successfully deployed, operated, and retrieved without hindrance to the MABS program. Preliminary data inspection confirmed that recorded information was correct and reasonably complete. The sensors yielded not only a record of sound speed structure at the array but an indication of array movement and shape during and after emplantment.

DESCRIPTION OF EXPERIMENT

(U) The three MABS environmental sensors (incorporating modifications to ensure their reliability) will be installed at site M-1, using an independent, taut subsurface mooring. One deployment for 45 days is scheduled.

The sensors will be programmed to record the following parameters every 5 min: sea pressure (±1%), temperature (±0.1°C), conductivity (±0.02 mmho/cm), current speed and direction (±0.05 knot, ±5°), compass orientation of pressure case (±3°), and instrument tilt (±0.5°). On retrieval, the sensors will be thoroughly inspected, and a preliminary assessment of the quality of the recorded data will be made.

(U) Three Braincon Model 381 histogram current meters will be included in the environmental array to measure current speed and direction only. (See tables 1 and 2.)

(U) The following sensor depths (in feet) are currently planned: 400, 2,000, 3,000 (current only), 5,600, 9,500 (current only), and 12,000 (current only).

DATA ANALYSIS PLAN

(U) Data analysis will include discussions of

- the variability in each parameter and in the computed sound speed as a function of time
- the correlation of current velocity at six measurement depths
- the influence of water mass circulation on the acoustic field
- the estimated array motion and shape (based on sensor tilt, pressure, and compass orientation).

DATA REPORTING PLAN

(U) The reporting plan includes

- A preliminary report containing a cruise narrative and a preliminary assessment of the data quality and processing progress, by 1 October 1972.
- Data processing completed on all instruments by 1 November 1972.

Table 1. (U) ENVIRONMENTAL ARRAY CURRENT METER SPECIFICATIONS (U)
(Braincon Model 381 Histogram Current Meter)

	Range	Threshold	Resolution	Accuracy*
Speed	0 - 5 knots	0.05 knot	0.07 knot	0.08 knot
	0 - 2.5 knots	0.05 knot	0.035 knot	8% full scale 0.20 knot
Direction	0 - 360°		3°	1%, 4°
Tilt Direction	0 - 360°		3°	±10°
Tilt Magnitude	0 - 30°		3°	±3°

*Accuracy valid for speeds below 3 knots as determined at NOIC, using latest available calibration corrections.

Table 2. (U) ENVIRONMENTAL DIGITIZER SPECIFICATIONS (U)
(Geodyne Model 775D)

	Range	Threshold	Resolution	Accuracy
Speed	0 - 7 knots	0.08 knot	0.02 knot	±0.05 to 0.1 knot
Direction	0 - 360°	±2°	±2.8°	±2 to ±10°
Tilt Direction	0 - 360°		2.8°	±2 to ±10°
Tilt Magnitude	0 - 45°			±0.3 to 0.4°

- Data analysis completed by 1 January 1973.
- Reports on all phases of the environmental data investigation, by 1 February 1973.

PRINCIPAL INVESTIGATOR

(U) The principal investigator for this event is M. Fecher, NUSC.

VII. EVENT 5 — SEDIMENT CORES

OBJECTIVE

(U) The objective of this event is to determine the acoustic and soils mechanics properties of the ocean bottom down to 20 ft, via sedment cores, in the general area of the suspended receivers. Two 20-ft piston cores at each of two sites and 10 "boomerang" cores between the sites will be obtained in the operating area. Several analyses of the cores will be conducted to determine the acoustic properties to be used in development of an acoustic model of the bottom and to determine the soils mechanics properties to be used in support of studies of array structure design and emplantment procedures.

DESCRIPTION OF EXPERIMENT

(U) Two Ewing core samples will be taken at the deployment sites. A modified Ewing corer with piston, 20-ft core barrel, and a 500-lb weight-stand will be used. A Phleger corer will be used as a tripping weight for the Ewing corer. Ten boomerang cores will be taken in a zigzag pattern on either side of the line joining the two sites.

DATA ANALYSIS PLAN

(U) The core liners will be cut into sections, labeled, and maintained at a low temperature, but not frozen. The cores will be shipped by air, upon completion of Phase 2, to the University of Rhode Island, where the following analyses will be performed: sediment sound velocity, bulk wet density, porosity, grain size distribution, organic content, carbonate content, Atterberg limits, and sheer strength.

DATA REPORTING PLAN

(U) The data reporting plan includes

- A preliminary report containing a narrative of the measurement program and a description of the cores, within one month of the completion of Phase 2
- A final report on the laboratory analyses of the properties of the cores, by 1 January 1973.

LEVEL OF EFFORT

(U) Laboratory analysis and reporting will require 1-1/2 man-months.

PRINCIPAL INVESTIGATOR

(U) The principal investigator for this event is J. Gallagher, NUSC.

Annex A

ENVIRONMENTAL DATA PLAN

(U) All environmental data will be forwarded to the Oceanographic Data Coordinator by 1 September 1972, by hand or by mailing, to U. S. Naval Oceanographic Office (Code 7005) Washington, D. C., 20390. Data such as AXBT, XBT, bathymetry, sound-velocimeter, and STD records will be machine digitized, processed, verified, and coded on punched cards or magnetic tape for final plotting. These data can also be made available in a format suitable for input to propagation loss prediction modeling programs. It is anticipated that this effort will be completed by 1 December 1972.

(U) The Oceanographic Data Coordinator will review, as promptly as possible after the exercise, the ship and aircraft environmental data obtained for completeness and adequacy for project objectives.

(U) Plots of environmental data made during or after the experiment will have the following formats:

a. XBT's, AXBT's, and other data shallower than 1000 m shall be plotted to the following scales: sound velocity on the abscissa to a scale of 20 m/sec per in.; depth on the ordinate to a scale (left hand) of 100 m per in. for a total scale length of 10 in. (1000 m); the right-hand ordinate scale will be labeled to show each 200 ft.

b. Composite displays showing each plot of sound velocity versus depth (for a given depth) at a position along the abscissa that indicates the time at which it was taken will have a time scale of 10 hr per in. along the abscissa.

c. Preliminary bathymetric profile diagrams will have a horizontal scale of 20 nmi per in. reading from west to east and a vertical scale of either 500 fathoms per in. or 1000 m per in.

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Research Scientific Plan

5. AUTHOR(S) (First name, middle initial, last name)

Ocean Science Department, NUSC

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d.	

10. DISTRIBUTION STATEMENT

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TD 4367 is Operation Plan	Department of the Navy

13. ABSTRACT

This document describes the scientific aspects of the signal and noise directionality, ambient noise, bottom characteristics, and oceanographic experiments that comprise Phase 2 of NORLANT 72. Experiment descriptions, data processing and reporting plans, levels of effort, and principal personnel are delineated for the studies to be conducted July-August 1972 in the Labrador Basin.

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KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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Labrador Basin						
Ambient noise						
Bottom characteristics						
Signal and noise directionality						

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IR 71-2	Fenner, D. F., et al.	SOUND VELOCITY AND BOTTOM CHARACTERISTICS FOR LRAPP ATLANTIC AREAS I, II, AND III (U)	Naval Oceanographic Office	710601	ADC008372; ND	U
T-71-NJ-4508-C	Larsen, H. L., et al.	LRAPP DATA COLLECTION (U)	Tracor, Inc.	710831	AD0517012; ND	U
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